**Magnets, Electromagnets, and Neutrino Beams – LESSON PLAN**Magnetic Interactions: A Visit to the North Pole

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| **Lesson # 4** | Magnetic Interactions: A Visit to the North Pole |
| Overview  Standard(s)  & Objectives | **Overview:** In this lesson students will  **Standards**:  3-PS2-2: Make observations and/or measurements of an object’s motion to provide evidence for how a pattern can be used to predict future motion.  (SEP:3, DCI: PS2.A; CCC: Patterns)  3-PS2-3: Ask questions about cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. (SEP: 1; DCI: PS2.B; CCC: Cause/Effect  5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects is directed down. (SEP: 7; DCI: PS2.B; CCC: Cause/Effect)  Math Content: Measurement and Graphing  **Objectives:** Students will explore interactions of magnets. They will make predictions, record observations, take measurements, and gather data. |
| Background  Information | * Magnets repel or attract. * Magnetic forces can be used to move objects. * Magnets have a north and south pole; like poles repel; opposites attract.   In this activity, student will line magnets up with like poles to demonstrate the force of repelling. Students will place magnets on a dowel and when like poles are facing each other, they will appear to “float”. Each time an additional magnet is placed on the stack, the distance between the magnets decreases due to the gravitational pull of the earth.  Students will work in small cooperative groups to complete the activity. They will need to figure out a way to measure the gaps between the repelling magnets to see what happens as more are added. |
| Materials | For Each Student:   * Science Notebook * Handouts: Activity Table, Graph, Measure the Distance Between Magnets   For Each Group:   * 6 flexible magnets (25 x 20 x 5 mm or 1 x ¾ x 2/16 inches) with a 5mm hole in middle **OR** 6 ring magnets marked with small stickers to designate like poles (do this prior to activity) * 1 dowel **OR** 1 pencil * 1 ruler with Metric and US customary markings   Optional per Group:   * small ball of clay (to help hold down the dowel) * 1 plastic bag or piece of wax paper to put the clay on   Have available items that may help with measuring the space between magnets:   * String * Different colored markers * Masking tape |
| Prior Knowledge | Magnets repel and attract each other.  Magnetic fields are strongest at the poles. |
| Launch (Time: 7-10 minutes) | |
| Engagement and Communication of Student  Expectations | Engagement: Watch the Video from Canadian Science and Technology Museum to introduce magnets and some common uses. <https://www.youtube.com/watch?v=tdBpokG4wLM>  Today students will use the forces of repel and attract to help gain an understanding of how magnetic forces interact.  Today students will stack magnets up on a dowel to see how using like and unlike poles interact.  Students will need to pay close attention to the positioning of the magnets’ largest faces to complete the activity, |
| Explore (Time=40-45 minutes) | |
| Procedure | Prior to the lesson, prepare magnets in advance so that like poles are marked with a red sticker while the other pole is left blank. This will help students designate if poles are the same or opposite which will help the activity.  Be sure to keep magnets away from devices such as computers and cell phones.   * Distribute the materials to students.   The goal for the students it to stack the like poles facing each other so that they repel each other and note how the magnets appear to “float” as a result. When another magnet is added, the amount of space in between the two magnets will decrease each time. |
| Questions | Questions for Student Exploration:  Predictions:   * What will happen if you put two magnets on an upright dowel?  How will they interact? * What will happen if you put more magnets on the same dowel or pencil? * What would happen if there was no dowel?   Discuss predictions and write them down.   * How do magnets interact? * Can you make the magnets bounce? * Can you find a way to measure the distance between magnets? * What did you notice? * When your group is done you’ll be comparing results with other groups so be as accurate as you can.   Teacher Tips:  Have the sides of one side of each magnet marked with a sticker to indicate like poles.  Have an assortment of materials available for students to come up with a way to measure the distance between magnets when all like poles are facing each other. (May have different colored markers, string, etc.)  Circulate while groups are in action. Assist any who are having trouble meeting the expectations. Students should be stacking the magnets so that the like poles repel.  Extension:  Use a longer dowel and see how many magnets students can gather to stack and measure. |
| Summarize (Time 10 minutes) | |
| Communicate | After each group has completed their activity, they find a buddy group to share results and see how they compare. Then those groups will report to the whole group when the class gathers.  What did you observe? How did the magnets act when stacked with like poles facing each other?  What happened to the distance between the magnets when more were added?  What are the big ideas of this investigation? |
| Terminology and Concepts to Solidify | Vocabulary:   * repel-push away. * attract-pull toward. * north pole -the pole that points toward the north when magnet is freely suspended. The north pole of one magnet will attract the south pole of another magnet. Conversely, the north pole of one magnet will repel the north pole of another magnet. * south pole-the pole of a magnet that points toward the south. The south pole of one magnet will attract the north pole of another magnet. It will repel the south pole of another magnet.   Concepts:   * Magnets repel or attract. * Magnetic forces can be used to move objects. * Magnets have two poles: like poles repel; opposites attract. |
| Connection  to Big Ideas (Phenomena) | Anchoring Event  Think about what happened during the initial video. How does what was witnessed today help you better understand the first video? |
| Follow Up/Practice | * BBC Magnetic Learning Game   <http://www.bbc.co.uk/bitesize/ks2/science/physical_processes/magnets/play/>  In this interactive game, students have to use various types of magnets to move objects before a thief can steal them. If students have trouble, information is given to help them make better choices as they try again. Magnetic principles are reinforced in an engaging way.  To Review Types of magnetic materials and principles:   * Game: Magnets and Springs Activity with Quiz   <http://www.bbc.co.uk/schools/scienceclips/ages/7_8/magnets_springs_fs.shtml> |
| Assessment | Measure the Distance Between Magnets Document |
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ACTIVITY TABLE

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| Predict what will happen: | Conduct the activity.  What happened? Write your observations below: |
| I think that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ will happen because\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. |  |
| How will you measure the distance between magnets on the dowel? Write your plan below: | Sketch what happened when 6 magnets were placed on the dowel. |
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| What happened to the distance between magnets when another magnet was added? Be sure to record the data from each trial. | What did you learn from your observations? Would putting your information into a graph help you make more sense of the results? |
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**Graph your Results.**Remember to create a title for your graph and label the X and Y axis.

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| **Predict what will happen when another magnet is added to the dowel. Then place the next magnet on the dowel. Record your results.** | **Prediction** | **Actual** |
| Magnet 1 |  |  |
| Magnet 2 |  |  |
| Magnet 3 |  |  |
| Magnet 4 |  |  |
| Magnet 5 |  |  |
| Magnet 6 |  |  |

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| **Distance** | 2 magnets | 3 magnets | 4 magnets | 5 magnets | 6 magnets |
| Prediction: |  |  |  |  |  |
| Between Magnet 1 & 2 |  |  |  |  |  |
| Between Magnet 2 & 3 |  |  |  |  |  |
| Between Magnet 3 & 4 |  |  |  |  |  |
| Between Magnet 4 & 5 |  |  |  |  |  |
| Between Magnet 5 & 6 |  |  |  |  |  |

**Measure the Distance Between Magnets**